Student Reference 9: Researching Information

Research involves finding and recording accurate information about a topic or subject. Information can be found just about anywhere. Here are a few ideas that you might use:

- library catalogues
- books, encyclopedias
- journals
- posters, brochures
- newspapers, magazines
- films, videos, CD-ROMs, DVDs
- Internet sites
- community professionals or experts
- government agencies (local, provincial, and federal)
- non-profit organizations

Using Library Resources

Library computer catalogues are a fast way to find books on the subjects you are researching. Most of these electronic catalogues have four ways to search: author, title, subject, and key words. If you know the author or title of a book, just type it in. Otherwise, use the subject and key word searches to find books on your topic.

- If you are doing a subject search, type in the main topic you are researching. For example, if you are searching for information on solar energy, type in "solar energy." If there are no books on that topic, try again using a more general category, like "renewable resources" or just "energy."
- If you are doing a key word search, type in any combination of words that have to do with your topic. To research solar energy, you might type words such as "renewable energy," "Sun," or "solar panels."

The library may also have a way to search for magazine articles, called a periodical search. A periodical is any publication that is published regularly, such as newspapers, magazines, and journals. Periodical searches may be done using a computer or by using special periodical indexes. Periodicals are especially useful for finding information on recent events. Ask your librarian how to do a periodical search.

Your library will also probably have a reference section where encyclopedias, atlases, and other reference books that must be used in the library are kept. These resources can provide you with accurate information on more general concepts and facts, such as the parts of the cell or the structure of an atom.

Using the Internet

The Internet is useful for finding information on many subjects. Make sure you know your school's policy about acceptable use of the Internet, and follow this policy whenever you use the Internet at school.

To find information quickly on the Internet, make use of special programs called search engines. A search engine scans the Internet for Web sites containing specific information. To find a search engine, ask your teacher or click on the search icon found at the top of your Internet browser. Here are some suggestions on how to search the Internet:

- In the appropriate place on the search engine Web page, type in key words or phrases that relate to your topic. For example, to find information on solar energy, you might use the following key words or phrases: "solar energy," "solar panels," or "renewable resources."
- When you click on the appropriate button (usually labelled "go" or "search"), the search engine will scan the Internet and then display a list of Web sites that contain your key words or phrases. You can then click on any Web site on the list to go directly to that site.
- If your initial search gives you a very long list, you may need to make your search more specific. Start your search again, but add other key words to your initial search terms. Some search engines allow you to search within the first list for additional terms without starting over. For example, if you were looking for examples of solar energy in Canada and your initial key words were "solar energy," you could add the key word "Canada" to your search to reduce the length of the list of sites.
- You might find you want to check a previously viewed site, so remember to record the addresses of any useful Web sites. Your Internet browser should have a way for you to keep a file of sites you want to visit again (these may be called either "bookmarks" or "favourites"). Check with your teacher or librarian to find out how to save Web site addresses.

Be aware that some Web sites may be strongly biased toward a specific point of view. Educational or government Web sites are generally reliable.

Note-Taking Charts

When researching, you need to record the information you collect in an organized manner. One way you could do this is to use a note-taking chart.

In both printed and electronic information sources, information is usually organized under headings. For example, the information you are reading now is under the heading "Note-Taking Charts." Use these headings as a tool for recording relevant information. Before you begin any in-depth reading, look at each heading and turn it into a question. Try to use "how," "what," or "why" to begin each question. Write your questions in your chart. Leave enough space between questions to record information as you read.

For example, a student was asked to prepare a report on the scientific meaning of work. She found a section in a book that had the following headings:

- The Meaning of Work
- Calculating Work
- Energy and Work

Figure 9.1 shows the student's note-taking chart:

Questions from Headings	Answers from Reading
What is the meaning of the word "work"?	– work is done when a force acts on an object to make the object move – If there's no movement, no work is done – just trying to push something isn't work—it's only work if the object moves
How do you calculate work?	
How are energy and work related?	

FIGURE 9.1 A note-taking chart keeps all your information organized as you work. It is similar to a data table used during a lab activity.

Recording Information Sources

As you do your research, you will look at many different sources. Whatever sources you use, you need to record and communicate them clearly. This allows you or anyone else to go back and recheck the information. If you do not present the reference sources you use, you may be committing plagiarism, which is taking or using someone else's words or ideas as your own.

Your teacher may want you to list your information sources in a specific format. Check this format before you begin your research so that you can collect the details you need. Your record should include at least the following:

- the title or name of the source
- the author's name, if known
- the name of the publisher
- the date the material was published
- the specific page numbers you consulted

Most lists of information sources are presented alphabetically, according to the name of the author (or editor). If there is no author or editor, alphabetize by the first word of the title (other than "a," "an," or "the.") Here are some examples of commonly accepted styles for presenting reference sources.

a) Books with one or more authors:
Trentsky, Ola, and Frank O'Brien. *The Life of Plants*. Edmonton: Glacier Press, 2001.

b) Books with one or more editors:
Singh, Vijay, ed. *Machines in Motion*. Calgary: Advance Press, 2000.

c) Books with no author or editor:
The Canadian Atlas of Climate. Vancouver: Three Spokes, 1999.

d) Encyclopedia
Lee, Hu. "Chemical Reactivity" *Encyclopedia of High School Chemistry*. 1999 ed.

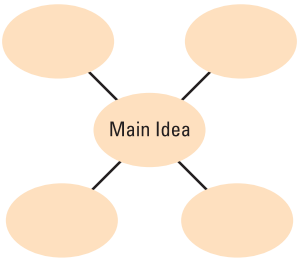
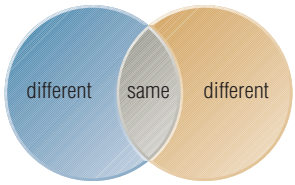
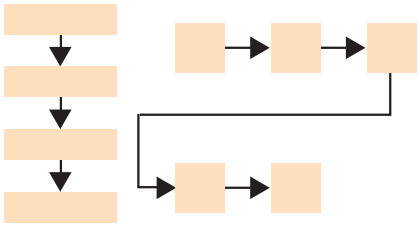
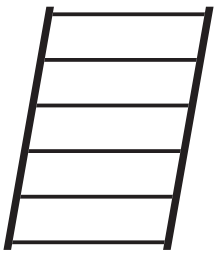
e) Government publications:
Government of Alberta. Alberta Learning. *Science Data Booklet*. Edmonton, 1999.

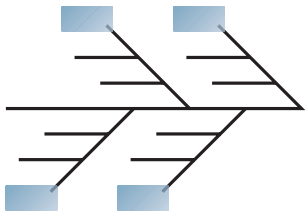
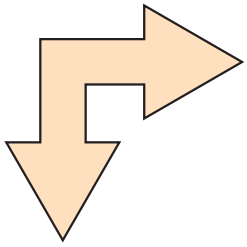
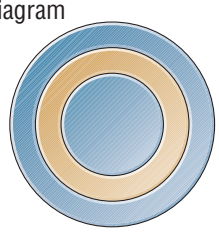
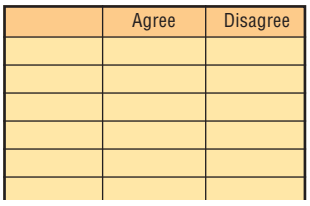
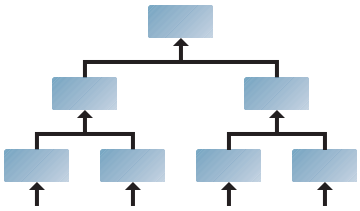
f) Periodical publications:
Kampa, Bisasu. "The Efficient Engine." *Everyday Technology* 14 Jan. 2003: 12–15.

g) Web sites:
Canadian Forestry Organization. *Sustaining Canada's Forests*. Aug. 2001. 12 Sept. 2003.
<http://www.canfor.org/sustain.html>.

Student Reference 10: Tools for Analyzing Information

Visual organizers are effective tools that can help you learn. They enable you to problem-solve and think critically by analyzing similarities and differences, inferring sequences, and establishing cause-and-effect relationships. They generate discussion and negotiation of ideas, extend comprehension of a concept, theme, or topic, and lead to organized representation and presentation of understandings. You can use them to brainstorm, to demonstrate what you know, and to organize your thoughts before writing a report or essay, or planning a presentation. The following chart outlines a number of graphic organizers, their intended purposes, and how to use them as you study science.

Type of Graphic Organizer	Purpose	Method
Concept Map or Web Diagram 	Used to clarify relationships and linkages between concepts, events, or ideas	Brainstorm ideas and link together from "big to small" with arrows or lines linking words. Cluster information around a central concept or idea.
Venn Diagram 	Used to visualize similarities and differences between two or more ideas, topics, or concepts	Brainstorm similarities, and list these in the overlapping section of the two circles. Then brainstorm differences and list these in the non-overlapping sections.
Flowchart or Sequence Chart 	Used to map out your thinking about an issue or to organize ideas for an essay or report	Brainstorm aspects of the whole event or concept. Select important aspects and put them into sequential order.
Ranking Ladder 	Used to rank ideas in order of importance	Brainstorm ideas and rank them in order from most important (bottom rung) to least important (top rung).

Type of Graphic Organizer	Purpose	Method
Fishbone Diagram 	Used to analyze cause-and-effect relationships	List the effect at the head of the "fish." Brainstorm possible causes and list them in each "bone." Rank the causes and circle the most probable ones, justifying your choice.
Right-Angle Diagram 	Used to explore the consequences of an idea and the impact of its application	Briefly describe the idea you are exploring on the horizontal arrow. Brainstorm consequences of the idea, and list these to the right of the horizontal arrow. Expand on one consequence, and list details about it along the vertical arrow. Describe social impacts of that trait below the vertical arrow.
Target Diagram 	Used to weigh the importance of facts and ideas	Brainstorm facts and ideas. Rank their importance and place the most important facts or ideas centrally, and the least important toward the outer ring.
Agree/Disagree Chart 	Used to organize data to support a position for or against an idea or decision	List a series of statements relating to a topic or issue. Survey agreement and disagreement before discussion. Survey again after discussion and research.
Cost/Benefit Chart 	Used to summarize the negative (costs) and positive (benefits) aspects of a topic or issue	List ideas or information relating to the topic or issue. Sort the ideas or information in a chart that includes the headings "Costs" and "Benefits."
Concept-Hierarchy Diagram 	Used to identify and sequence the subordinate concepts needed to understand a higher-order concept	Place the higher-order concept at the top of the page. Then consider the question, "What concepts need to be understood before the higher-order concept above can be grasped?" The same question is then asked for each of the subordinate concepts and a hierarchy of connected concepts is created.

Student Reference 11: Writing Reports

Whether your work in science involves the inquiry process, the problem-solving process, or the decision-making process, the final step is always to effectively communicate your results. There are many different ways you may communicate results: you might give an oral presentation, create an electronic presentation, or make a video. Many times, however, you will be required to write a report.

The list below summarizes all the things you need to do when communicating scientific information in a written report.

- Give your report a title.
- Tell your readers why you did the work.
- State your hypothesis, describe the design challenge, or outline the scope of the issue.
- List the materials and equipment you used.
- Describe all the steps you took when you did your experiment; designed, made, and tested your product; or researched the issue.
- Communicate your experimental data, the results of testing your product, or the background information on the issue.
- Analyze and interpret the results of your experiment, product test, or research on the issue.
- Describe your conclusions.

If you are writing a report on an experiment or a product design, you will need to follow all eight of these steps.

Give your report a title.

Write a brief title at the top of the first page of your report. Your title may be one or two words or a short sentence, but it should describe the experiment you performed, the product you designed and made, or the issue you investigated.

Tell your readers why you did the work.

Use a heading such as "Introduction" or "Purpose" for this section. Describe your reasons for doing a particular experiment, designing and making a particular product, or considering a specific issue. If you are writing about an experiment, state the question you investigated. If you designed a product, explain why this product is needed, what it will do, who might use it, and who might benefit from its use. If you considered an issue, state the issue and explain why you found it important or interesting enough to research.

State your hypothesis and design statement, describe the design challenge, or outline the scope of the issue.

If your report is about an experiment, state your hypothesis and your design statement. Your hypothesis must indicate the relationship between the manipulated and responding variables. A design statement is an outline of the general plan for testing the hypothesis, and identifies all the variables. Refer to *Student Reference 2: The Inquiry Process* for more information.

If your report is about a product you designed, describe the reasons behind your design. Explain how and why you chose your design over other possible designs, including features such as the materials you used.

If your report is about an issue, briefly outline the scope of the issue, such as who is affected, the locations that are affected, and any other related information. You may wish to include this information in the introduction to your report.

List materials and equipment.

List all the materials and equipment you used for your experiment or design project. Your list can be in point form, or set in a table or chart. Include the exact amounts of materials used (e.g., the masses of substances used in an experiment or the number of nails used to build a model). Include the proper units and exact measurements for all materials used. Also include in this section any diagrams that show how you set up your equipment or prepared your materials. You may wish to use the heading "Materials and Equipment" for this section. If you are writing a report about an issue you have researched, you do not need to complete this step.

Describe the steps you took.

If you performed an experiment, describe in detail all the steps you carried out in order to complete it. If you made a product, outline what you did to design and make your product, and how you tested it. If you had to alter your design based on your testing, describe how you did this as well. If you researched an issue, briefly describe the kinds of sources you used, such as reference books, government sites, or interviews with experts. You may wish to use the heading "Procedure" or "Method" for this section.

Show your experimental data, results of testing, or background information.

In this section of your report, show the data or information you collected while performing the experiment, testing your product, or researching an issue. Use data tables and diagrams to clearly communicate the results of an experiment or of tests of a product. If you performed your experiment more than once, include the results for each trial. If you tested several designs of your product, give results for each design. If your report is about an issue, this section should be a concise description of only the information that is essential for a reader to understand the issue and all the related viewpoints. Diagrams or pictures can also help you to communicate the background information on an issue. Give this section a heading such as "Data," "Observations," or "Background Information."

Analyze and interpret the results of your experiment, product testing, or research.

This section must communicate how you analyzed the data or information you collected, and the interpretations you made based on that analysis. Include any calculations or graphs you used in analyzing your data. Refer to *Student Reference 6: Math Skills* and *Student Reference 7: Graphing* for more information on analyzing data. If your report concerns an issue, describe the results of your analysis. For example, if you analyzed the costs and benefits of an issue, you would describe whether the costs outweighed the benefits (or vice versa). If you used a particular tool to analyze your information, describe the tool. *Student Reference 10: Tools for Analyzing Information* describes several such tools. You may wish to use the heading "Analysis and Interpretation" for this section.

Describe your conclusions.

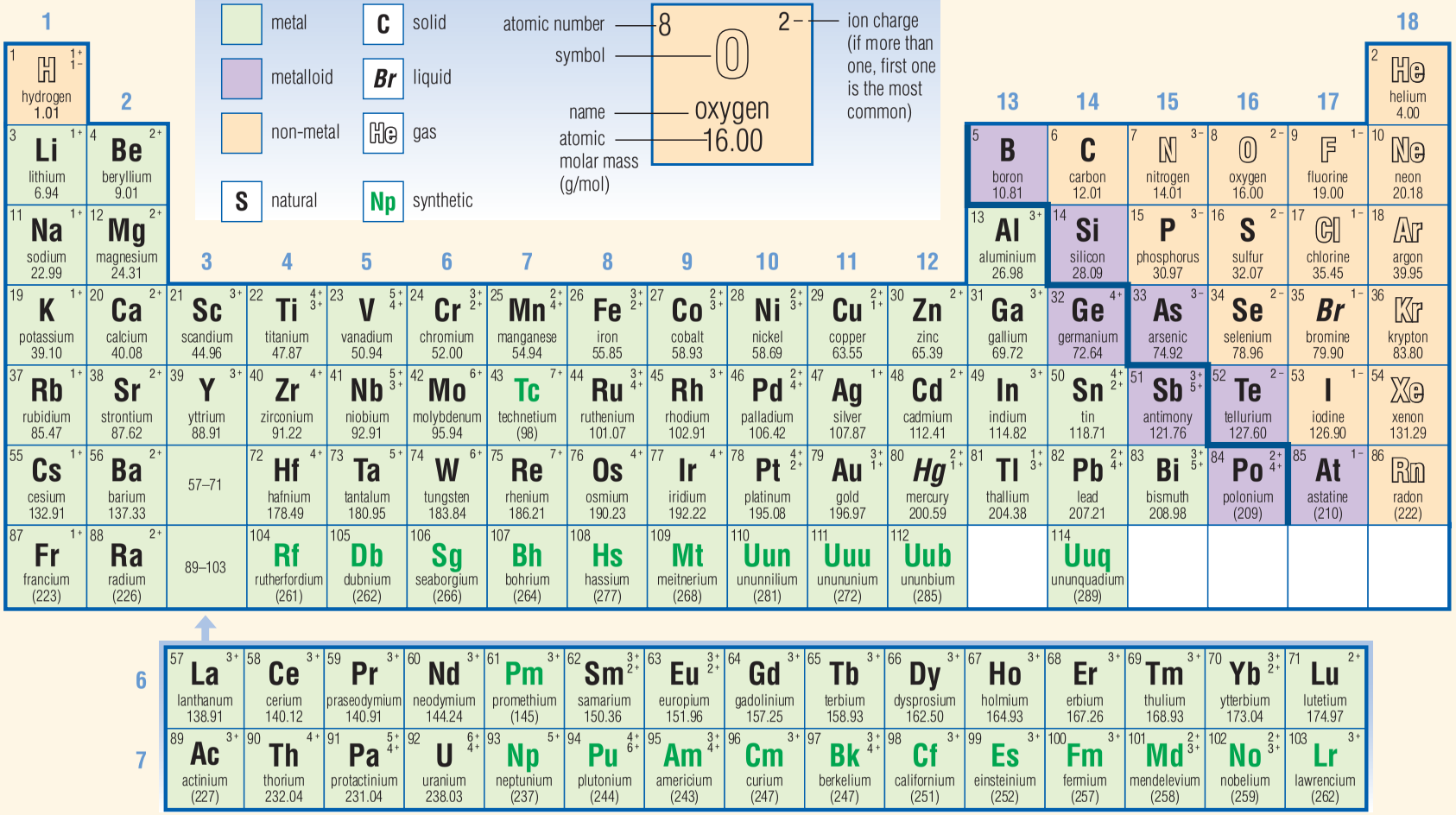
The last section of your report can be called "Conclusions." In one or two paragraphs, explain what your tests and experiments showed, or what decision you made as a result of your research.

If you performed an experiment, state whether your results supported your hypothesis. If the results do not fully support your hypothesis, describe how you might adjust the hypothesis based on your results, and how you might test this new hypothesis. Describe the practical application your experimental results might have for the world outside the classroom.

If you made a product, explain whether your design worked the way you intended. If you changed the design of your product after testing, explain why one design is better than another. Describe the practical application your product might have for the world outside the classroom.

If you considered an issue, explain why you made the decision that you did. Briefly summarize the supporting evidence for your decision. If necessary, explain how your decision responds to different viewpoints on the issue.

A. Periodic Table



B. Some Common Chemical Compounds

Chemical Name	Common Name	Formula	Description and Uses
ammonia	ammonia	$NH_{3(g)}$	• used in the manufacture of fertilizers, explosives, and synthetic fibres, and as a refrigerant • produced during nitrogen cycle by plants
benzene	benzene	$C_6H_{6(l)}$	• used in the production of nylon and polystyrene, and as a solvent • is a component of gasoline
carbon dioxide	carbon dioxide	$CO_{2(g)}$	• produced by cellular respiration of living things and by combustion of fossil fuels • used by plants for photosynthesis • is a greenhouse gas
ethanol	grain alcohol	$CH_3CH_2OH_{(l)}$ $C_2H_5OH_{(l)}$	• used as a solvent, in the manufacture of medicines, and as a gasoline additive
glucose	glucose	$C_6H_{12}O_{6(s)}$	• is a simple sugar, produced by plants during photosynthesis from carbon dioxide and water
methane	methane	$CH_{4(g)}$	• produced by the decomposition of organic matter • is a major component of natural gas • is a greenhouse gas
methanol	wood alcohol	$CH_3OH_{(l)}$	• used in the production of wood adhesives and plastics, as a solvent for paints and dyes, and as gas-line anti-freeze
nicotine	nicotine	$C_{10}H_{14}N_{2(s)}$	• addictive substance in tobacco products
water	water	$H_2O_{(l)}$	• is the universal solvent • is a vital component of all living cells • liquid water covers over 70% of Earth's surface

C. Solubility of Some Common Ionic Compounds in Water at 298.15 K

Ion	Group 1 NH_4^+ H_3O^+ (H^+)	ClO_3^- NO_3^- ClO_4^-	CH_3COO^-	Cl^- Br^- I^-	SO_4^{2-}	S^{2-}	OH^-	PO_4^{3-} SO_3^{2-} CO_3^{2-}
solubility $\geq$ 0.1 mol/L (very soluble)	all	all	most	most	most	Group 1 Group 2 NH_4^+	Group 1 NH_4^+ Sr^{2+} Ba^{2+} Tl^+	Group 1 NH_4^+
solubility < 0.1 mol/L (slightly soluble)	none	none	Ag^+ Hg^+	Ag^+ Pb^{2+} Hg^+ Cu^+ Tl^+	Ca^{2+} Sr^{2+} Ba^{2+} Ra^{2+} Pb^{2+} Ag^+	most	most	most

Group 1: Li^+, Na^+, K^+, Rb^+, Cs^+, Fr^+
Group 2: Be^{2+}, Mg^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Ra^{2+}

D. Diagnostic Tests for Some Common Substances

Substance Detected	Description of Test
oxygen gas	Collect a small amount of gas in a test tube. Insert a glowing wooden splint into the test tube. If oxygen gas is present, the splint will ignite and you will see a flame.
hydrogen gas	Collect a small amount of gas in a test tube. Insert a burning wooden splint into the test tube. If hydrogen gas is present, you will hear a popping sound.
carbon dioxide gas	Collect a small amount of gas in a test tube. Insert a burning wooden splint into the test tube. If carbon dioxide gas is present, the flame will be extinguished (go out). Since other gases can also extinguish the flame, the presence of carbon dioxide must be confirmed by testing it with limewater (a solution of calcium hydroxide). Place a few drops of limewater into the test tube. If the gas is carbon dioxide, the limewater will turn milky.
bases	Dip a piece of red litmus paper into the solution. If the solution is a base (i.e., it has a pH > 7), the litmus paper will turn blue.
acids	Dip a piece of blue litmus paper into the solution. If the solution is an acid (i.e., it has a pH < 7), the litmus paper will turn red.

E. Common Polyatomic Ions

Polyatomic Ion	Formula
acetate (ethanoate)	CH_3COO^-
ammonium	NH_4^+
benzoate	$C_6H_5COO^-$
borate	BO_3^{3-}
carbide	C_2^{2-}
carbonate	CO_3^{2-}
hydrogencarbonate (bicarbonate)	HCO_3^-
chlorate	ClO_3^-
chlorite	ClO_2^-
hypochlorite	ClO^- or OCl^-
chromate	CrO_4^{2-}
dichromate	$Cr_2O_7^{2-}$
cyanide	CN^-
hydroxide	OH^-
iodate	IO_3^-
nitrate	NO_3^-
nitrite	NO_2^-
oxalate	$OOCCOO^{2-}$
hydrogenoxalate	$HOOCCOO^-$
perchlorate	ClO_4^-
permanganate	MnO_4^-
peroxide	O_2^{2-}
persulfide	S_2^{2-}
phosphate	PO_4^{3-}
hydrogenphosphate	HPO_4^{2-}
dihydrogenphosphate	$H_2PO_4^-$
silicate	SiO_3^{2-}
sulfate	SO_4^{2-}
hydrogensulfate	HSO_4^-
sulfite	SO_3^{2-}
hydrogensulfite	HSO_3^-
hydrogensulfide	HS^-
thiocyanate	SCN^-
thiosulfate	$S_2O_3^{2-}$

F. Thermodynamic Properties of Selected Substances

Name	Formula	Heat of Fusion (kJ/mol)	Heat of Vaporization (kJ/mol)	Specific Heat Capacity (J/g·°C)
aluminium	$Al_{(s)}$	10.79	294	0.897
copper	$Cu_{(s)}$	12.93	300.4	0.385
gold	$Au_{(s)}$	12.72	324	0.129
iron	$Fe_{(s)}$	13.81	340	0.449
nickel	$Ni_{(s)}$	17.04	377.5	0.444
silver	$Ag_{(s)}$	11.28	258	0.235
zinc	$Zn_{(s)}$	7.07	123.6	0.388
ice	$H_2O_{(s)}$	6.01	—	2.00
water	$H_2O_{(l)}$	—	40.65	4.19
steam	$H_2O_{(g)}$	—	—	2.02
methanol	$CH_3OH_{(l)}$	3.22	35.21	2.53